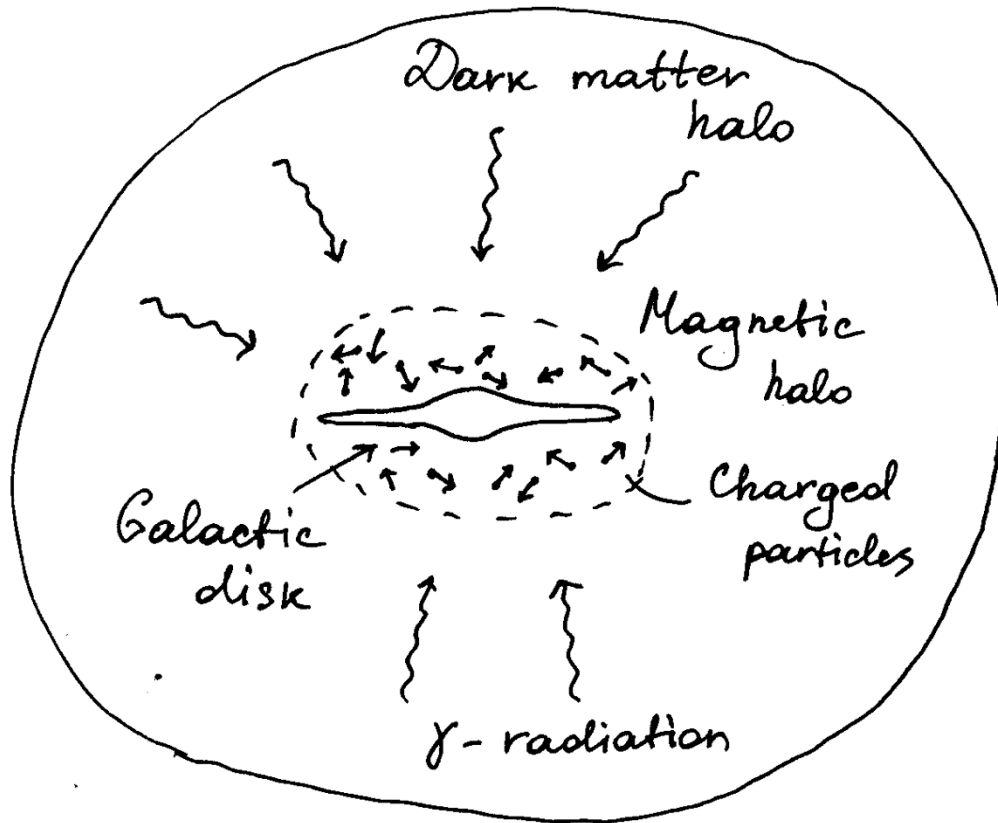# On a possible solution to gamma-ray overabundance arising in dark matter explanation of cosmic antiparticle excess

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Conventional dark matter distribution
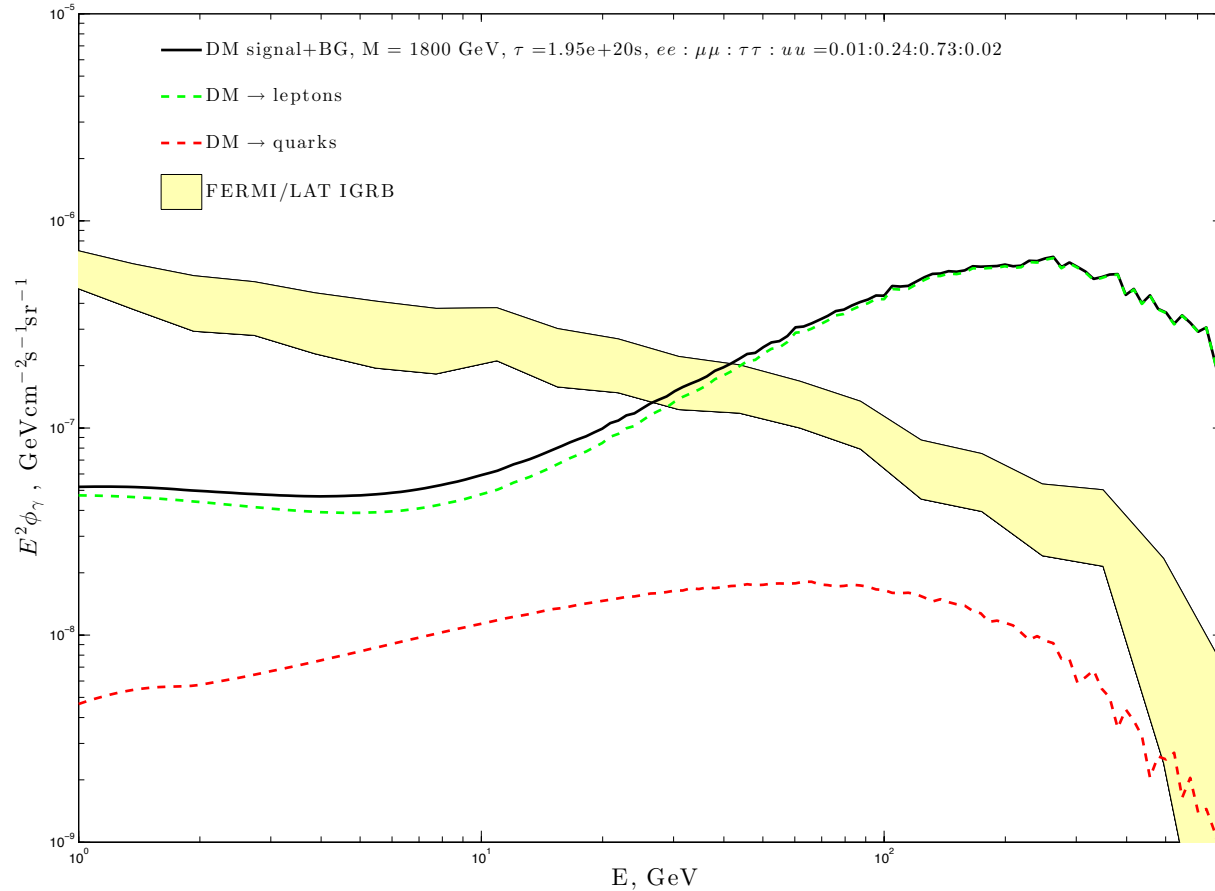

Dark matter is distributed isotropically all around the Galaxy

Gamma rays come from the whole dark matter halo (!)

Charged cosmic rays only comes from magnetic halo

Leads to overproduction of gamma-rays…

Diffuse gamma-ray background from DM decays (1800 GeV)

# How about squeezing the "habitat" of unstable dark matter into a Galactic disk?

How about squeezing the "habitat" of unstable dark matter into a Galactic disk?

Why not?

JiJi Fan, Andrey Katz, Lisa Randall and Matthew Reece, "Double-Disk Dark Matter", *Phys.Dark Univ.* **2** (2013) 139-156, e-Print: arXiv:1303.1521 [astro-ph.CO]

Disk-shaped unstable DM distribution

If unstable DM particles possess self-interaction they can slow down (as ordinary matter does)

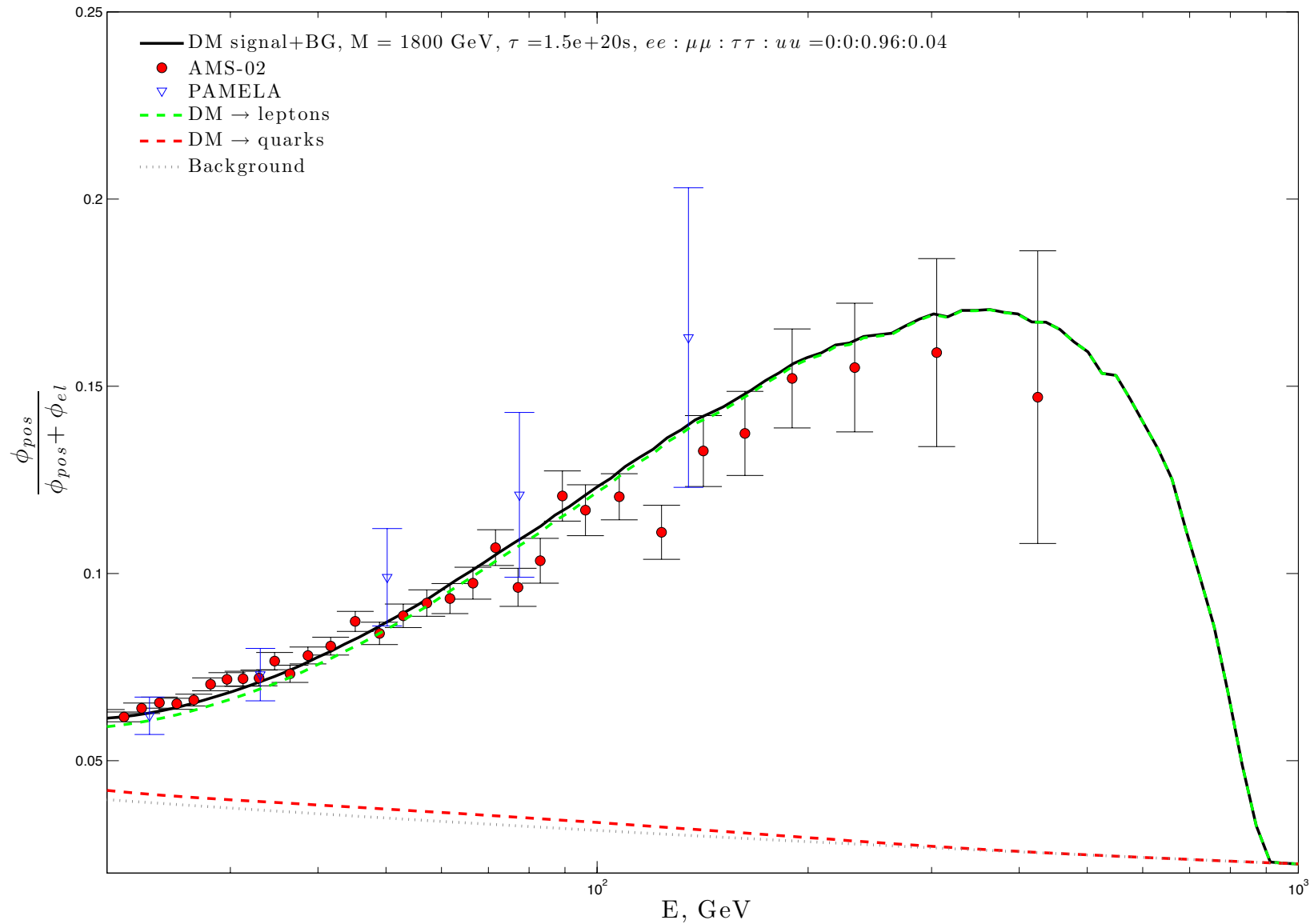⟹
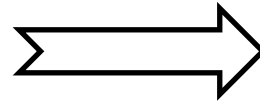
Formation of DM disk-like structure (DDM) *presumably coinciding with Galactic disk* is possible!
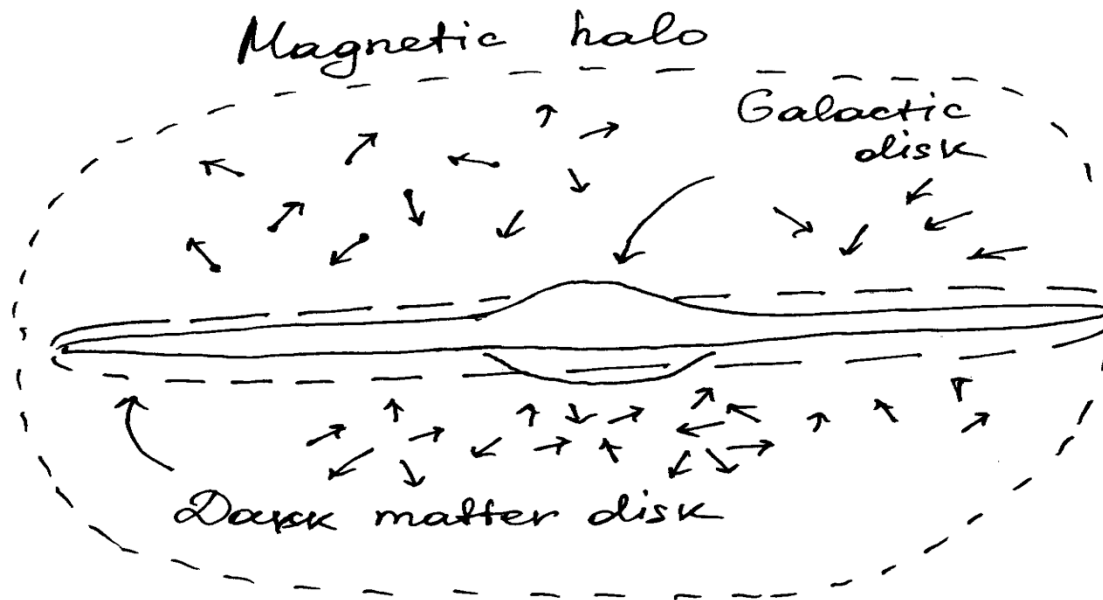
Thus charged particles still diffuse in the halo while gamma ray "pollution" is now significantly reduced!

Positron fraction (1800 GeV, DDM)

Antiproton flux (1800 GeV, DDM)

The figure shows a plot of $E^3 \phi_{\bar{p}}$, $\mathrm{GeV^2 cm^{-2} s^{-1} sr^{-1}}$ versus Kinetic energy, GeV.

Legend:
— DM signal+BG, M = 1800 GeV, τ =1.5e+20s, $ee : \mu\mu : \tau\tau : uu$ =0:0:0.96:0.04

○ PAMELA (2012)

Antiproton background

Gamma-rays (1800 GeV, DDM)

Plot of $E^2 \phi_\gamma$, $\mathrm{GeV\,cm^{-2}s^{-1}sr^{-1}}$ versus E, GeV.

Legend:
- **DM signal+BG, M = 1800 GeV, $\tau = 1.5\mathrm{e}{+}20\mathrm{s}$, $ee : \mu\mu : \tau\tau : uu = 0{:}0{:}0.96{:}0.04$** (black solid line)
- **DM → leptons** (green dashed line)
- **DM → quarks** (red dashed line)
- **FERMI/LAT IGRB** (yellow band)
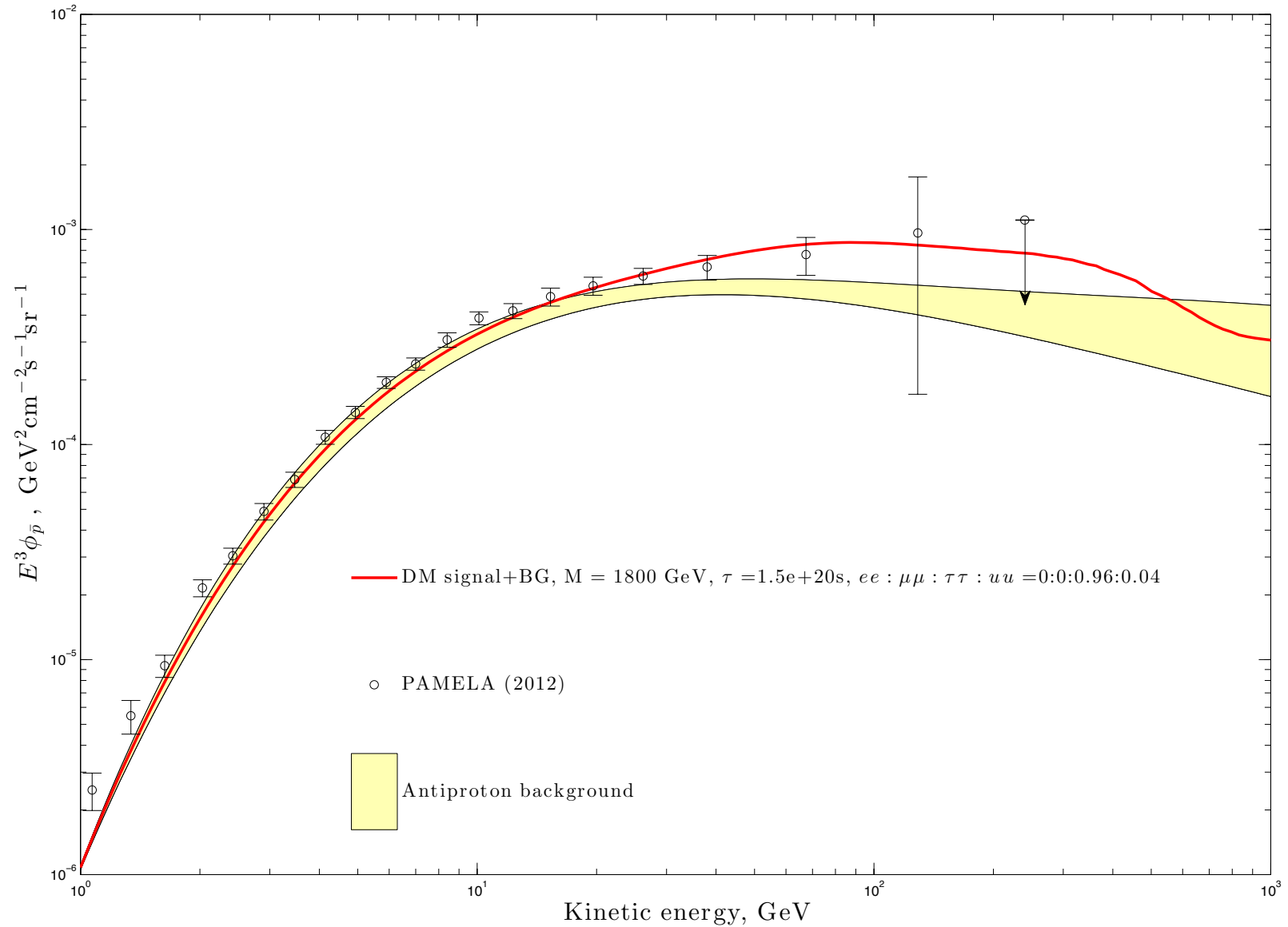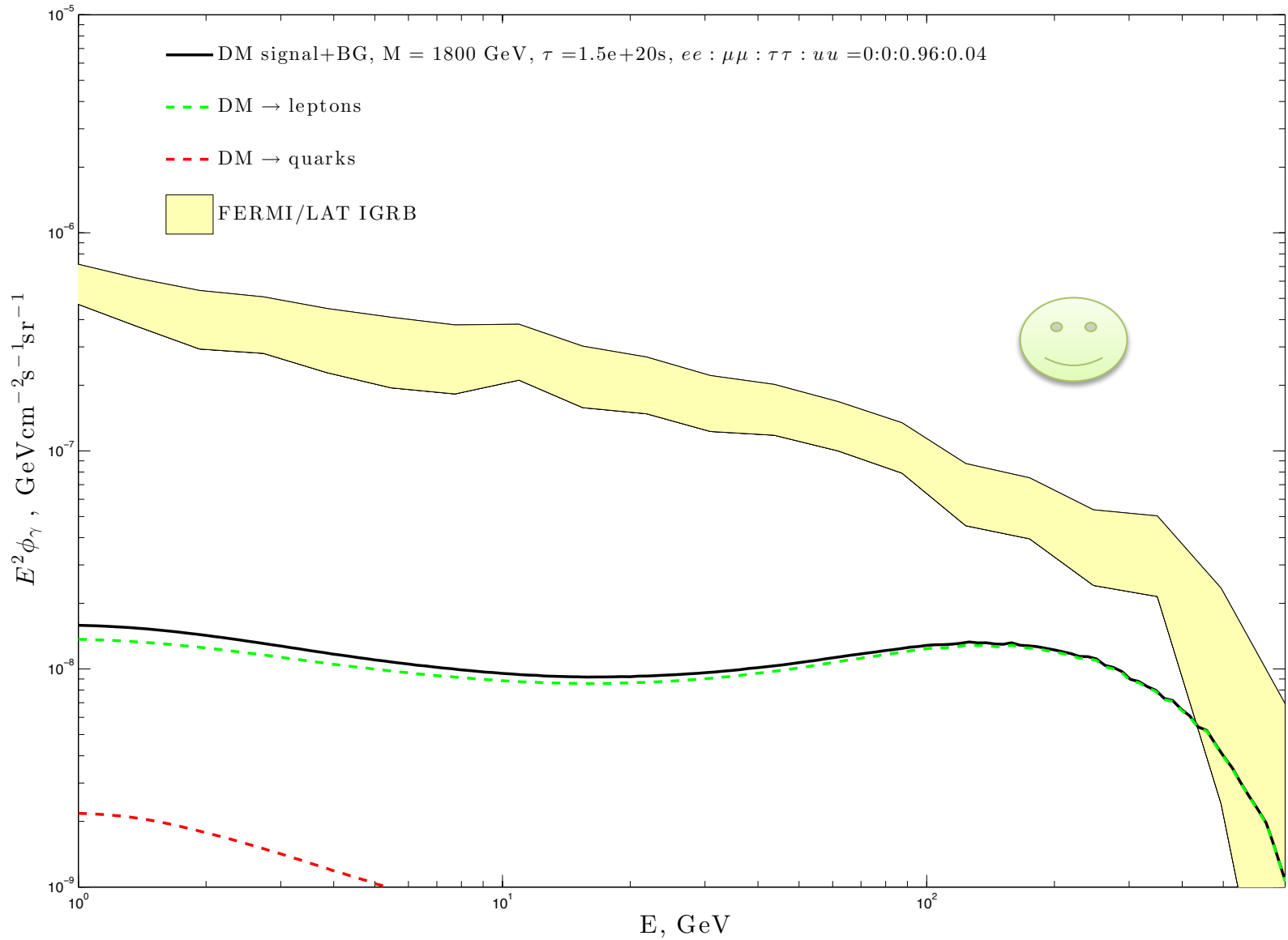
Results and prospects:

- We proposed a possible solution to the problem of gamma-ray overproduction.
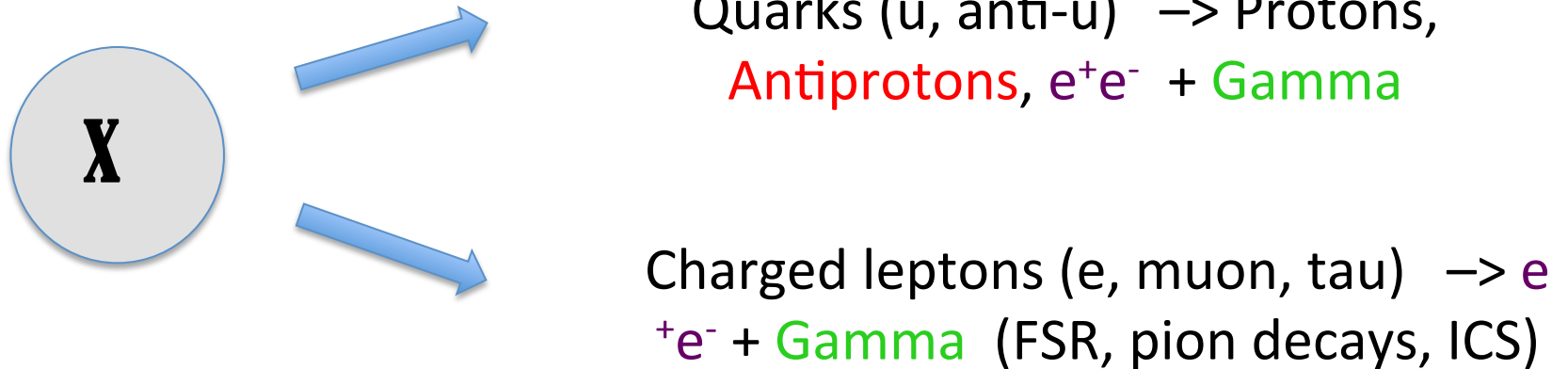
- Develop a rational self-interacting decaying dark matter being capable of disk-like structure formation ;
- Check its consistency with other astrophysical and cosmological data;
- Obtain the best-fit values of the model and explain their origin;
- Make predictions for future experimental searches (anisotropy?).

Thank you for attention!

Backup slides

Decaying dark matter model

X

Quarks (u, anti-u) –> Protons, Antiprotons, e^+e^- + Gamma

Charged leptons (e, muon, tau) –> e^+e^- + Gamma (FSR, pion decays, ICS)

Parameters:

- Mass of the particle, M_x ;
- Lifetime, τ;
- Fraction of unstable DM, ξ;
- 3 Branching ratios: **ee**, **μμ**, **ττ**;
  (uu = 1 – Σ Br)